
Interlibrary loan in U.S. health sciences libraries: journal article use

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Health sciences libraries in the United States use the National Library of Medicine (NLM) DOCLINE® system to request more than two million items annually through interlibrary loan (ILL). Ninety-seven percent of all ILL requests are for journal articles. In this study, NLM analyzed four million ILL requests entered into the DOCLINE system during two twelve-month periods ending September 30, 1992. The requests were analyzed at both the journal title level and article level. Data for the two years were found to be remarkably similar. Results showed that a large number of journals are required to fill ILL requests and that there is a relatively low number of repeat requests for most journal articles. Seventy-six percent of journal articles analyzed were requested only once, and fewer than 1% were requested more than ten times. About 39% of journals used to fill ILL requests were indexed in MEDLINE® at some time, while 84% of the articles supplied were indexed in MEDLINE. Ninety-two percent of articles supplied were from English-language journals. Sixty-seven percent of articles were published in the most recent five years, and 85% in the most recent ten years. The 100 most frequently requested articles for each of the two years were examined to determine characteristics such as language, where they were indexed, and the subject matter. This study has provided valuable information for planning of NLM's interlibrary document delivery services and also should have significance for libraries and other organizations involved in document delivery.

INTRODUCTION

Changes in information transfer technologies during the first part of the 1990s have strengthened prospects for achieving what libraries have worked toward for many decades: fast, easy access to published literature at reasonable cost. Document delivery services that appeared in libraries and the commercial sector during the 1980s have matured into information products targeted to specific markets. OCLC has invested heavily in telecommunications and software to expand its menu of products to include electronic publishing and document delivery interfaces for participating libraries [1]. The Research Libraries Group (RLG) has introduced Eureka™ and CitaDel®, which combine citation searching and document delivery services, and Ariel® for delivery of document images over the Internet. Commercial services such as UnCover2 use scanning technology and fax trans-

mission to provide articles on demand to both libraries and individual users [2].

In addition, numerous experimental projects, such as the National Library of Medicine (NLM) SAIL project [3-4] and Elsevier's TULIP project [5] are exploring both the technical and economic feasibility of disseminating electronically stored journals. Many journal articles are now in electronic form from their creation through the publication process, although they are available only in print form to subscribers. The recent paper issued by the Association of Research Libraries (ARL), "Maximizing Access, Minimizing Costs: A First Step toward the Information Access Future" [6], sketches the essential linkages needed to implement a comprehensive ILL and document delivery system to achieve cost-effective, efficient resource sharing among libraries.

With electronic storage and delivery of text images a reality, the creation of virtual libraries—libraries

functioning without printed journals within physical reach—becomes feasible.

There are few published reports of recent, large-scale studies of ILL transactions. Most reported studies of ILL have been carried out within single organizations or local consortia for purposes of collection development and resource sharing. The Fourniture de Documents sur Réseau Electronique (FOUDRE) pilot project in France, in which eighteen libraries cooperated to scan and electronically store images of articles from three central libraries during 1991/92, determined that only 2% of the articles requested through ILL were requested more than once [7].

NLM previously has published results of two studies on its ILL service, and these profiled requests to NLM in 1984 and 1988 at the journal title level [8–9]. NLM serves as a back-up resource for materials not held by other medical libraries and receives more than 300,000 ILL requests per year. Both studies revealed that a very large number of different journals were needed to fill ILL requests received by NLM, but that very few of these journals were requested heavily. Most ILL requests for biomedical literature, however, are for individual journal articles. This paper reports the results of an analysis of ILL transactions at the article level.

Biomedical libraries have used NLM DOCLINE®, an automated request and routing system for ILL, since 1985. DOCLINE was designed to build upon existing interlibrary lending and borrowing patterns and to permit resource sharing within the National Network of Libraries of Medicine (NN/LM)™. By the end of 1992, more than 2,400 medical libraries were using DOCLINE, requesting more than two million items annually. Serial requests consistently constitute close to 97% of all requests entered into the system. Eighty-five percent (85%) of all requests are filled by NN/LM libraries, with an additional 7% filled by NLM, for an overall fill rate of 92%. This paper reports the findings from an analysis of the approximately four million serial requests entered into the DOCLINE system for two consecutive twelve-month periods (i.e., two fiscal years), ending September 30, 1992.

METHODOLOGY

Data from the DOCLINE system, SERLINE®, MEDLINE®, and NLM's Master Serials System (MSS) were used to analyze ILL requests entered into the DOCLINE system by U.S. medical libraries. Data for each of the two years of ILL requests were analyzed separately to provide a baseline for future study and comparison.

DOCLINE users submit requests for serials by entering a unique identifier (UI) for a citation found in the MEDLINE or HEALTH databases; by entering a

UI for the serial title (SERLINE UI); or by typing in all required fields of a citation. The DOCLINE system links to several NLM databases to complete both user and citation information. When the MEDLINE or SERLINE UI is entered into DOCLINE, the system uses the SERHOLD® database of holdings of U.S. biomedical libraries, along with a routing table for the library entering the request, to route the ILL request automatically to a library that reports holding the journal requested. The ILL transaction data captured by DOCLINE are organized in INQUIRE® databases. Because of the large number of records required for this analysis, computer programs were written to work on segments of large databases, sorting transactions and truncating records to identify unique citation requests. Requests that were not linked to either a MEDLINE or SERLINE UI by the requesting library were not included in this study.

DOCLINE transaction data contain only limited information about the journal title requested. To obtain information to better characterize the journal titles requested and provided through ILL, use data were transferred to NLM's Master Serials System. The MSS contains detailed information about all journal titles in the NLM collection and many journals held by other libraries in the NN/LM.

In addition, to review in detail the 100 most frequently requested articles for each year, the brief data from the ILL transactions were uploaded to a Paradox® database. The citations then were amplified with information from the MEDLINE and HEALTH databases, including the Medical Subject Heading (MeSH®) terms, and from the MSS.

RESULTS

In Table 1, DOCLINE data is summarized for the fiscal years 1991 and 1992 on filled requests that contained the SERLINE UI. There were 1.93 million filled requests analyzed for fiscal year (FY) 1991 and 2.13 million analyzed for FY 1992; these numbers represent 88% of all requests input to DOCLINE and 90% of all requests for journal articles. The unique journal titles used were those used to fill the journal requests analyzed for the study.

The analysis of the data showed a remarkable similarity between the two years in nearly all of the characteristics studied. Both years of data are reported to demonstrate the consistency of the findings.

Distribution of journals used

In FY 1992, 19,670 unique ILL journal titles were requested, and 16,335 were used to fill the approximately two million requests. In FY 1991, there were 18,839 titles requested and 15,527 used to fill requests. As indicated by the following data on serials from

Table 1
DOCLINE network ILL data

	FY 91	(%)	FY 92	(%)
Total requests input to DOCLINE	2,205,776		2,432,748	
Journal requests	2,138,339	(97)	2,363,354	(97)
Journal requests filled	1,969,188	(92)	2,171,640	(92)
Unusable records—				
article-level analysis	42,035	(2)	38,035	(2)
Journal requests analyzed	1,927,153	(90)	2,133,259	(90)
Journal titles requested	18,839		19,670	
Journal titles used	15,527		16,335	

the SERLINE file, the total number of titles requested in the network annually approaches the total number of currently published journal titles.

During the period of this study, a mean of 79,000 serial titles were included in the SERLINE file, NLM's database of bibliographic data for biomedical serials held by NLM and by libraries contributing to the SERHOLD database. Of these titles, 28,000, or 35%, were currently published serials, and an estimated 24,000 of these contained articles. These serials included journals, newsletters, and conference proceedings. (The remaining 4,000 serials included publications such as directories, indexes, monographic series, and annual reports.)

The distribution of title use—i.e., the number of times a title was used to fill a request by the medical libraries—was nearly identical in each of the two years studied. Nearly half (7,772) of the journal titles used were used five or fewer times; 58% (9,375) were used fewer than ten times; and only 10% (1,700) of titles were used more than 300 times in a year within the entire network of libraries.

The most heavily used titles for the two years studied are listed in Table 2. Nine titles are in the top ten for both years. The requests analyzed were for articles published during all years of publication of the journal. Several titles below have been published for many decades, and articles were requested for most years of publication.

Distribution of journals in unfilled requests

In each of the two years studied, requests that were not filled in the network or by NLM were for articles from approximately 3,300 journal titles. Libraries entered into DOCLINE a number of reasons for unfilled requests: the item is at the bindery, the library does not hold the specific volume or issue requested, or the item is temporarily unavailable, for example. Also, the requesting library may cancel its request or may not wish to pay the photocopying charge. A review of these 3,300 titles showed that 31% were published in languages other than English. More than half (52%) of the 3,300 titles had ceased publication. Most of the titles, 66% in FY 1991 and 64% in FY 1992, were requested only once, and many titles did not cover biomedical subjects.

In FY 1992, fifty-four titles were requested ten or more times and not provided. Of these, only six ever were indexed for MEDLINE, specifically for the *International Nursing Index* or *Index to Dental Literature*. None were indexed for *Index Medicus*. In FY 1991, forty-seven titles were requested ten or more times and not provided, and, again, only six were indexed for MEDLINE at some time; none for *Index Medicus*. Only one of the indexed titles was requested in both years. In most cases, very few libraries reported holding these titles, and many were not held by NLM.

Distribution of articles used

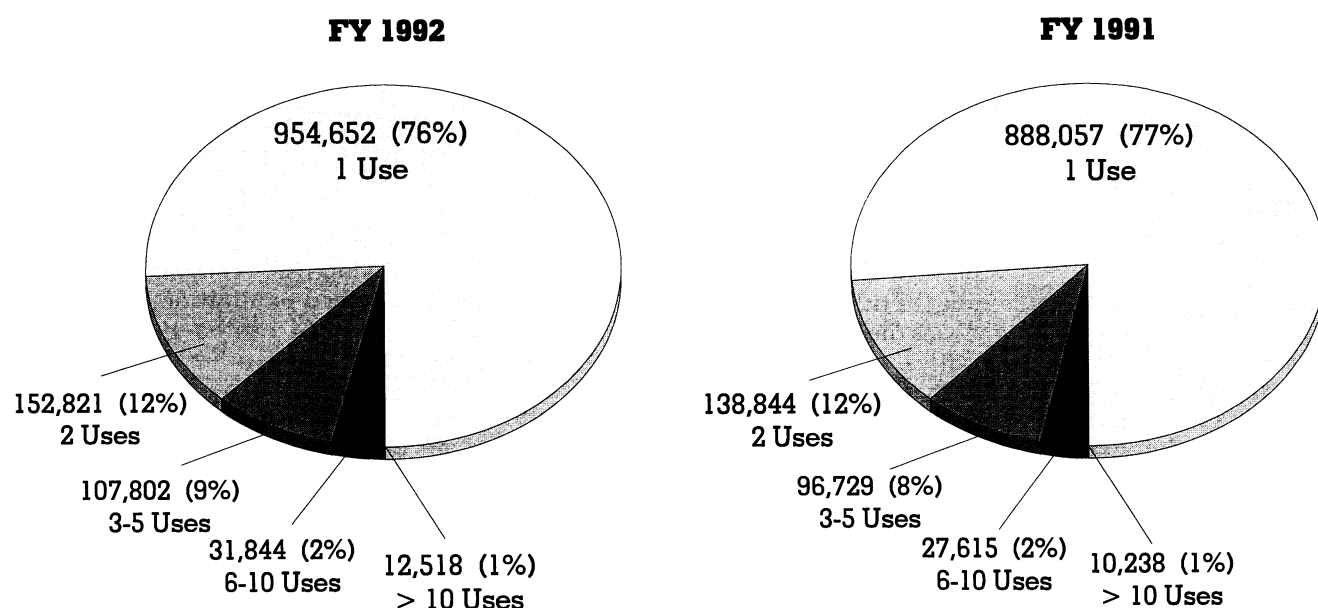
There were 2.13 million articles delivered through ILL in FY 1992 and 1.93 million articles in FY 1991. The number of times an individual article was requested by medical libraries is shown in Figure 1. Again, the distribution was nearly identical for the two fiscal years. Some 76% of the articles were used only once, and 97% were used five or fewer times. Less than 1% of the articles were used more than ten times to fill requests.

There were only eleven articles used more than 100 times in FY 1992 and fourteen articles used more than

Table 2
Most frequently used titles

FY 91		FY 92	
Journal titles	ILLs	Journal titles	ILLs
<i>Progress in Clinical & Biological Research</i>	7,668	<i>Nursing Times</i>	7,687
<i>Nursing Times</i>	7,297	<i>Annals of the New York Academy of Sciences</i>	6,348
<i>Annals of the New York Academy of Sciences</i>	6,044	<i>Nursing Standard</i>	6,310
<i>Journal of Advanced Nursing</i>	4,822	<i>Journal of Advanced Nursing</i>	6,244
<i>Medical Journal of Australia</i>	4,818	<i>Progress in Clinical & Biological Research</i>	5,659
<i>Lancet</i>	4,565	<i>Medical Journal of Australia</i>	5,395
<i>JAMA</i>	4,542	<i>Spine</i>	5,309
<i>Spine</i>	4,321	<i>Lancet</i>	5,123
<i>Social Science and Medicine</i>	4,303	<i>Social Science and Medicine</i>	4,716
<i>Clinical Orthopaedics & Related Research</i>	4,095	<i>JAMA</i>	4,575

Figure 1
Journal articles used to fill DOCLINE requests



100 times in FY 1991. The journal titles in which these articles were published are listed in Table 3. It is interesting to note that the most heavily requested articles were not published in the most heavily used journals, with only one exception, *Spine*. The most heavily requested articles were on topics of very current interest.

Articles indexed in MEDLINE

Approximately 3,700 journals currently are indexed for MEDLINE, NLM's largest database of biomedical

information. For this study, however, all journals ever indexed for MEDLINE were included, because articles dating from the beginning of MEDLINE in 1966 may be requested. Approximately 7,250 titles ever have been indexed in MEDLINE.

MEDLINE titles and articles are used extensively in ILL. Although only 38% and 39% of all journals used by network libraries to fill ILL requests in FY 1991 and FY 1992 respectively ever were indexed in MEDLINE, 83% and 84% of articles supplied during the two years were indexed in MEDLINE. Also, of the 3,700 journals indexed for MEDLINE during this

Table 3
Journal titles with articles requested more than 100 times

FY 91		FY 92	
Journal titles	ILLs	Journal titles	ILLs
<i>Surgical Endoscopy</i>	251	<i>Michigan Nurse</i>	217
<i>Drugs</i>	212	<i>Progress in Cardiovascular Nursing</i>	176
<i>Journal of Psychiatric Research</i>	189	<i>Health Care Management Review</i>	155
<i>Health Care Management Review</i>	179	<i>Journal of Psychiatric Research</i>	147
<i>Family Practice</i>	177	<i>Current Opinion in Rheumatology</i>	142
<i>New Jersey Medicine</i>	138	<i>Journal of the Florida Medical Association</i>	138
<i>Current Opinion in Rheumatology</i>	136	<i>Comprehensive Therapy</i>	111
<i>Surgical Endoscopy</i>	132	<i>Journal—South Carolina Medical Association</i>	108
<i>Michigan Nurse</i>	125	<i>Annals of the Rheumatic Diseases</i>	105
<i>Spine</i>	120	<i>Spine</i>	103
<i>American Journal of the Medical Sciences</i>	116	<i>QRB—Quality Review Bulletin</i>	102
<i>Journal of Rheumatology Supplement</i>	116		
<i>Psychosomatics</i>	106		
<i>Journal of Quality Assurance</i>	102		

study, only 103 in FY 1991 and 104 in FY 1992 were not requested at all by DOCLINE libraries. Of these unrequested journals, thirty-nine titles were not used in either year. In both years, more than 60% of unrequested journals were foreign-language titles.

Language of publication

In both years studied, 92% of articles supplied were from English-language journals. When multilingual titles that contain English-language articles are included, nearly 99% of all articles delivered are covered, showing that the demand for foreign-language titles in U.S. biomedical libraries is quite low.

Date of publication

In each fiscal year, the number of requests for articles published in the most recent year was low, apparently because the fiscal year includes only nine months of that calendar year (January through September) and because there is a time lag between publication and indexing. During both periods studied, more than 95% of all ILL requests were for articles published since 1970, 85% for articles published in the most recent ten years, and 67% in the most recent five years (Figure 2).

Most heavily requested articles

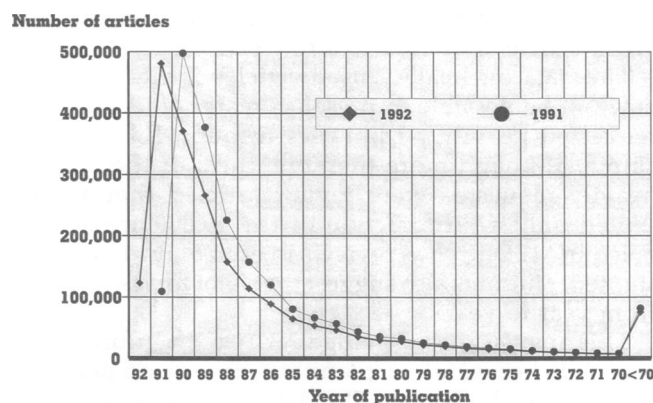
Only a few articles are requested often in the entire network. The 100 most heavily requested articles accounted for 7,765 requests (0.004%) in FY 1991, an average of 78 requests per article, with a range of 51 to 251 requests. The 100 articles were published in eighty different journals. In FY 1992, the 100 most heavily requested articles accounted for 7,865 requests (0.004%), or 79 requests per article, with a range of 58 to 217. These articles appeared in eighty-one unique journals.

In both years, all 100 top articles were published in English-language journals. Ninety-six percent of the articles were published between 1988 and 1991. Twenty-five of the heavily used articles were in the top 100 list in both years. In FY 1991, 95 articles were indexed for MEDLINE with 65 indexed for *Index Medicus* (IM), 32 for *International Nursing Index* (INI), and 12 for *Hospital Literature Index* (HLI). In FY 1992, 84 articles were indexed for MEDLINE, 55 for IM, 31 for INI, and 26 for HLI. (Articles may be indexed in more than one of these publications.) Thirty-nine of the articles in FY 1991 and 35 in FY 1992 were review articles. Nursing and health care topics each accounted for approximately 25% of the articles.

MeSH subjects

To determine whether heavily used articles focused on certain medical subjects or issues, words in the

Figure 2
Date distribution of article requests



titles of the articles were matched with major MeSH headings assigned. The major heading selected was the one that most closely matched the title of the article. The following headings were assigned to four or more articles:

FY 1991

- "QUALITY ASSURANCE, HEALTH CARE" (20 articles)
- "ATTENTION DEFICIT DISORDER" w/ "HYPERACTIVITY" (7)
- "FATIGUE SYNDROME, CHRONIC" (5)
- "CATHETERS, INDWELLING" [with Heparin] (4)
- "REFLEX SYMPATHETIC DYSTROPHY" (4)

FY 1992

- "FATIGUE SYNDROME, CHRONIC" (11 articles)
- "MANAGED CARE PROGRAMS" (9)
- "LAPAROSCOPY" (7)
- "QUALITY ASSURANCE, HEALTH CARE" (6)
- "HEPATITIS C" (4)
- "FETAL ALCOHOL SYNDROME" (4)

DISCUSSION AND CONCLUSION

This analysis of more than four million ILL requests filled by medical libraries using DOCLINE demonstrates the wide use of the published medical literature. A very large proportion of the journals currently published are requested at least once, but a relatively small number are requested many times. More significant is the distribution of use of any individual article, because the great majority of biomedical articles requested were requested only once in the country during a year. Most biomedical articles requested in the United States are recently published, English-language articles.

These findings raise questions about the cost-effectiveness of converting all printed journal articles re-

quested to electronic form and storing items for future access. The data show that only a relatively small number of biomedical journals are used heavily for interlibrary document delivery and that use of any given article is limited to a few years.

The data on heavily used articles indicate that it may not be possible to preselect material likely to be requested heavily by libraries through ILL. For example, although more than one third of the articles heavily requested were review articles, they represented only a tiny fraction of the 40,000 articles labeled in MEDLINE as reviews in each of the two years studied. Findings also suggest that "hot topics" change from year to year.

This analysis has provided NLM with information that will be useful in planning document delivery services for the future. The data presented here also should have significance for libraries and other organizations considering reformatting printed publications into electronic form for delivery and for those concerned with copyright issues as they relate to ILL. It is important to recognize, however, that these data do not include the on-site use of journals by the 2,400 DOCLINE libraries. In considering specific implications, such as for journal collection and retention policies and reformatting, health sciences librarians will have to use these findings in conjunction with knowledge of their own specific situations.

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